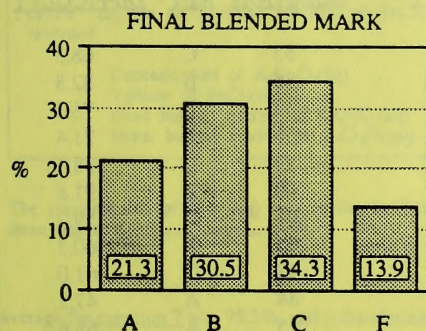
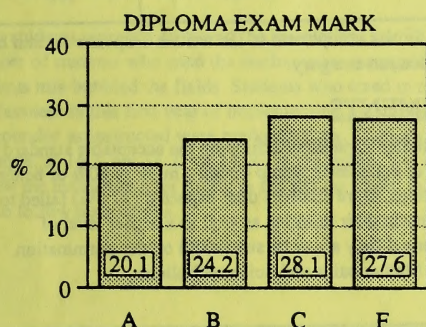
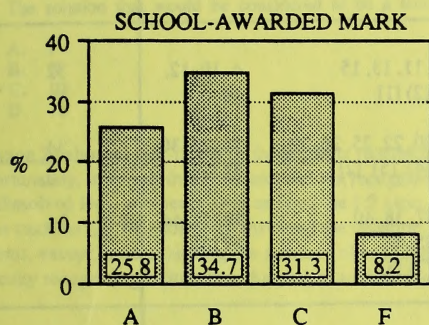


Student Evaluation

Chemistry 30 Diploma Examination Results



The summary information in this report is intended to provide teachers, school administrators, students, and the general public with an overview of results from the June 1990 administration of the Chemistry 30 Diploma Examination. The information is most helpful when used in conjunction with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. The first annual provincial report containing a detailed analysis of the combined January and June results is available this fall.

DESCRIPTION OF THE EXAM

The Chemistry 30 Diploma Examination consists of three parts: a multiple-choice section of 49 questions worth 70%, a numerical-response section of seven questions worth 10%, and a written-response section of three questions worth 20%.

ACHIEVEMENT OF STANDARDS

The information reported is based on the final blended marks achieved by 8 125 students who wrote the June 1990 examination.

- 86.1% of these students achieved the acceptable standard (a final blended mark of 50% or higher).
- 21.3% of these students achieved the standard of excellence (a final blended mark of 80% or higher).

PROVINCIAL AVERAGES

- The average school-awarded mark was 68.5%.
- The average diploma exam mark was 61.8%.
- The average final blended mark, representing an equal weighting of the diploma and school marks, was 65.5%.

SUBTEST RESULTS

When analysing any detailed examination results, please bear in mind that subtest results cannot be directly compared.

Machine scored: 36.3 out of 56

Written response: 6.9 out of 14

•Course Content

- Chemical Energetics: 13.9 out of 22
- Acids and Bases: 14.4 out of 24
- Oxidation-Reduction: 14.8 out of 24

•Process Skills: 21.1 out of 37

- Multiple-choice questions 3, 4, 6, 7, 11, 12, 14, 15, 20, 22, 24, 26, 28, 29, 30, 31, 32, 33, 39, 40, 44, and 47,
- numerical-response questions 1, 3, 4, 5, 6, and 7, and written-response questions 2 and 3.

•Cognitive Levels

- Knowledge: 13.5 out of 19
- Comprehension and Application: 23.6 out of 39
- Higher Mental Activities: 6.1 out of 12

EXAMINATION BLUEPRINT

Each question on the examination is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in June 1990 according to these classifications. Numbers with square brackets [] indicate written-response questions, those with round brackets () indicate numerical-response questions, and those without brackets indicate multiple-choice questions.

Reporting Category	Questions by Cognitive Level			Examination Emphasis (%)
	Knowledge	Comprehension and Application	Higher Mental Activities	
Chemical Energetics	1, 2, 5, 6, 7, 8	3, 9, 11, 13, 15 (1), (2) [1]	4, 10, 12, 14	32
Acids and Bases	16, 17, 18, 21, 23, 27, 29	19, 20, 22, 25, 26, 32 (3), (4), (5) [2]	24, 28, 30, 31 [2]	34
Oxidation-Reduction	33, 34, 35, 41, 48, 49	36, 37, 38, 40, 43, 45, 46 (6), (7) [3]	39, 42, 44, 47 [3]	34
Examination Emphasis (%)	27	53	20	100

Note: For reporting purposes, the Higher Mental Activities component of the written-response section has been combined with the Comprehension and Application category.

RESULTS and EXAMINERS' COMMENTS

The examination has a balance of question types and difficulties and is designed so that a student capable of achieving the acceptable standard would obtain a mark of 50% or better on the examination. Students achieving the standard of excellence would obtain a mark of 80% or better on the examination. Despite the parallel structure of this examination to previous examinations, more students than expected (27.6%) failed to achieve the acceptable level. Future examinations will require students to demonstrate clarity in their thinking as well as a higher level of thinking on a broader range of goals. Students will need to achieve these learner expectations if they are to be successful on the examination. For information concerning the 1990-91 diploma examinations, please consult the 1990-91 Mathematics and Sciences bulletin.

MULTIPLE CHOICE

QUESTION	KEY	DIFFICULTY*	QUESTION	KEY	DIFFICULTY	QUESTION	KEY	DIFFICULTY
1	C	82.1	18	C	82.6	35	C	68.3
2	A	76.7	19	B	76.2	36	B	82.8
3	C	62.8	20	D	63.8	37	D	76.3
4	B	55.8	21	B	40.3	38	A	71.4
5	D	45.0	22	C	81.2	39	D	38.1
6	A	77.7	23	B	63.5	40	B	91.8
7	D	73.7	24	A	29.7	41	C	59.2
8	D	87.7	25	C	67.8	42	B	60.3
9	A	85.0	26	C	86.2	43	D	61.0
10	B	76.1	27	A	66.3	44	A	47.2
11	D	57.6	28	B	47.7	45	A	68.6
12	B	59.3	29	C	73.2	46	B	65.2
13	C	87.3	30	A	32.4	47	D	61.3
14	A	50.5	31	D	52.1	48	C	55.3
15	D	79.0	32	B	79.3	49	A	65.5
16	D	87.8	33	D	78.8			
17	D	81.2	34	A	82.8			

*Difficulty – percentage of students answering the question correctly

MULTIPLE CHOICE (continued)

The questions that follow are selected to exemplify what is required to meet the acceptable standard and the standard of excellence.

Four solutions of equal concentration were tested for conductivity, reaction to litmus, and reaction with zinc metal. The results were tabulated:

Solution	Conductivity	Litmus	Zinc
I	good	blue to red	produced $H_2(g)$
II	good	no change	no reaction
III	poor	blue to red	produced $H_2(g)$
IV	none	no change	no reaction

22. The solution that would be considered to be a solution of a weak acid is

A. I
B. II
*C. III
D. IV

Question 24 showed that 75.6% of the students recognized that the solution would be basic. Unfortunately, over half these students did not recognize that there is a ratio between solute and dissolved ions, and hence they omitted the 1:2 ratio. Consequently, fewer than one-third of the students (29.7%) correctly answered the question. This result suggests that most students, except those achieving the standard of excellence or close to the standard, have difficulty recognizing ratios other than 1:1 in acid-base chemistry.

Question 22 showed that most students (81.2%) correctly analysed the data and recognized the properties of a weak acid. Those students who answered incorrectly did not appear to make a common mistake, which suggests that students achieving the acceptable standard have a good knowledge of the operational definitions of acids.

24. The pH of 7.5×10^{-3} mol/L $Ba(OH)_2(aq)$ is

*A. 10.18
B. 9.88
C. 4.12
D. 3.82

NUMERICAL RESPONSE

Most students correctly followed the instructions for filling in the answer sheet. However, the maximum number of students who used the mathematics instructions increased 1.4%; approximately 0.2% of the students mis-bubbled the fields. Students who erred in recording correct answers did not lose marks for carelessness in this first year of implementing the numerical-response questions. However, answers that were not rounded as instructed were marked wrong. Students should be rounding and recording 14.246, for example, as 14.2, not 14.25 or 14.20. In the future, it is expected that students will correctly round off and follow the instructions for filling in the answer sheet. In general, students should not expect marks when they fail to follow instructions.

Question	Answer	Difficulty (%)
1	8.83	49.6
2	28.0	34.4
3	4.16	38.7
4	85.8	53.6
5	3.31	52.0
6	4.50	28.2
7	1.15	75.5

In a titration experiment, $K_2Cr_2O_7(aq)$ was used to determine the concentration of $Fe^{2+}(aq)$ in an acidified solution of $FeCl_2(aq)$. The following data were recorded:

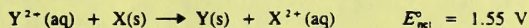
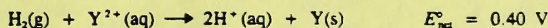
Concentration of $K_2Cr_2O_7(aq)$	0.250 mol/L
Volume of $FeCl_2(aq)$	10.00 mL
Final burette reading of $K_2Cr_2O_7(aq)$	30.2 mL
Initial burette reading of $K_2Cr_2O_7(aq)$	0.2 mL

6. The concentration of $Fe^{2+}(aq)$ ions in the $FeCl_2(aq)$ solution in moles per litre, to three digits, is _____ mol/L.

The average for question 6 was 28.2% and it discriminated very well between strong and fairly strong students. The most frequent mistake (23.3%) students made was omitting the 1:6 ratio between the $Cr_2O_7^{2-}(aq)$ and the $Fe^{2+}(aq)$. Following that, the most common error (4.1%) was using a 6:3 ratio. Inverting the ratio was not a problem; only 0.3% of the students did this. This suggests that only students achieving the standard of excellence can correctly write the equation and use the appropriate ratio to solve redox problems.

The average for question 7 was 75.5%, and it discriminated between fair and weak students. Students' most common mistake (6.4%) was their adding of voltages to yield an incorrect value of 1.95 V. Another common mistake they made (5.0%) was their response of 1.55 V, which suggests that students picked this voltage from the equation that contained $X^{2+}(aq)$. These errors suggest that students achieving the acceptable standard can obtain a numerical value for the voltage that corresponds to an unknown half-reaction.

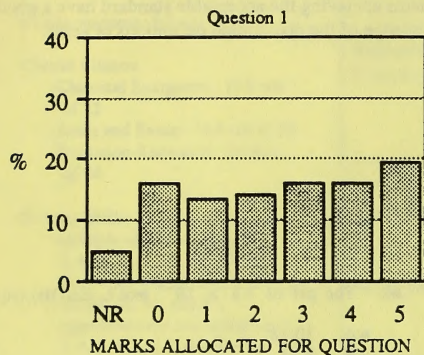
A student collected data for reactions using hydrogen and two unidentified metals labelled X(s) and Y(s).



7. The standard reduction potential for the reaction $X^{2+}(aq) + 2e^- \rightarrow X(s)$ in volts, to three digits, is _____ V.

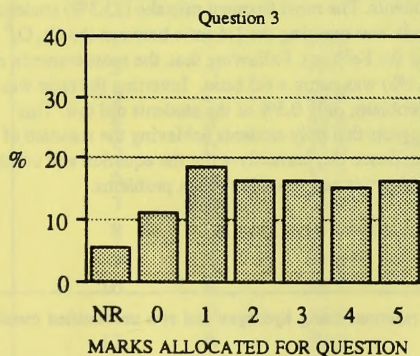
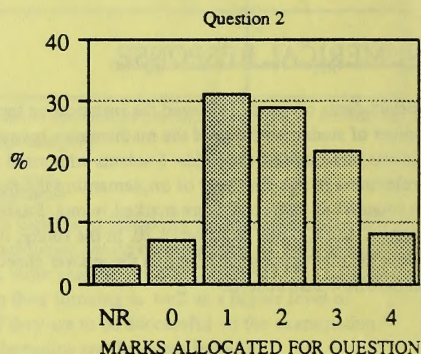
WRITTEN RESPONSE

The level of achievement on the written-response section was only fair; about half the students (52.1%) achieved a mark of 7 or better out of 14. This was due to the poor performance on question 2, which was about 25% lower than field test results had indicated. Students' inability to answer this question well accounts, in part, for their failure to attain the acceptable standard.



Question 1 showed that one-third of the students could not determine what was needed to solve the question and, as a result, obtained a mark of 2 or less. This group of students failed to write a balanced chemical equation for the combustion of ethanol and failed to calculate the appropriate molar heat of combustion. Students could still obtain a passing mark if they used an incorrect value, such as the molar heat of formation of ethanol, in subsequent calculations. Generally, students who correctly wrote a balanced chemical equation were able to calculate the molar heat of combustion and were good at solving the calorimetric aspect of the problem. These students handled the algebraic manipulation of variables well. They also recognized that the reaction was exothermic and that, hence, the final temperature should be higher than it was initially. Some common errors that prevented these students from earning full marks for this question were failing to balance the oxygen in the equation, using the negative sign on the ΔH value throughout the question, and failing to distinguish the final temperature from the change in temperature. On this 5-mark question, the average mark was 2.52 for 50% of the available mark.

Question 2 was not answered as well as was expected. Almost all students identified Lynn's explanation as being incorrect. Many students, however, had difficulty explaining their reasoning. Some could not differentiate between a nuclear proton and a hydrogen ion; most focused on what was correct in Pat's explanation rather than on what was incorrect in Lynn's. In general, students answered the second part of the question well, demonstrating that they understand and are able to use the acid-base indicator chart. A large number of students correctly selected methyl red and bromocresol green as the indicators. Most of them knew that bromocresol green would display its intermediate color, confirming that the pH value is above 3.8. Common errors made in this section were that students selected methyl orange to determine the lower pH limit, and that they failed to relate the color of the indicators to the pH of the solution. Students received lower marks for lack of clarity and for incomplete explanations. On this 4-mark question, the average mark was 1.87 for 47% of the available mark.



Question 3 was answered as well as was expected. A large number of students had difficulty selecting the oxidizing agent; they incorrectly selected Cl_2 or Cl^- . Most students recognized that the reaction involved zinc and so chose it as the reducing agent. Students with the correct reactants and products did not have problems balancing the equation with states or correctly interpreting the mole ratio. However, a large number of students failed to use the mass of zinc that reacted and instead used either the initial or final mass of zinc. In general, students performed the stoichiometric process well; they paid careful attention to rounding off to the proper number of significant digits and to their use of units throughout. However, they did not pay the same attention to detail in the overall organization of their responses. In the last part of the question, most students identified the correct chemical changes, but they presented their correct answers as inferences rather than as observations. Some failed to read the question carefully and, as a result, stated what was occurring during the reaction rather than what was indicated at the completion of the reaction. Another common problem occurred when students tried to indicate the completion of the reaction by selecting and using acid-base indicators; most selected inappropriate indicators. Those students who did select an appropriate indicator and gave a correct observation received full marks for this section. On this 5-mark question, the average mark was 2.44 for 49% of the available mark.

For further information, contact Phill Campbell or Don Loerke at the Student Evaluation Branch, 427-2948.

